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MODEL 31

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Operating INSTRUCTIONS

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MEASUREMENTS
A McGRAW-EDISON DIVISION
BOONTON NEW JERSEY

MODEL 31
INTERMODULATION METER

Operating INSTRUCTIONS

NO PART OF THIS MANUAL MAY BE
REPRODUCED IN WHOLE OR IN PART
EXCEPT BY PERMISSION OF
MEASUREMENTS

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A McGRAW-EDISON DIVISION
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DESIGN IMPROVEMENTS ON MODEL 31 REQUIRE THE FOLLOWING CHANGES IN THE INSTRUCTION MANUAL:-

Page 1 - In "Table of Specifications" under "Tubes" change "5Y3GT" to "6X5GT".

Page 7 - Para. 12 (5) Change "5Y3GT" to 6X5GT".
Para. 12 (8) Change "5Y3GT" to 6X5GT".

Page 8 - C4 Should Read:
CAPACITOR: fixed; paper; .05 mfd. 400 vdcw; 1-1/4" lg. x 7/16" dia.; two axial wire leads. Moulded plastic. Measurements Corp. Dwg. H-5516.

C5 Should Read:
CAPACITOR: fixed; paper; .02 mfd. ± 10%; 600 vdcw; hermetically sealed, metal case; 1-5/8" lg. x 9/16" dia.; mineral oil filled; two axial wire leads. Measurements Corp. Dwg. H-3753.

Page 9 - C16 Should Read:
CAPACITOR: fixed; paper; .05 mfd. ± 20%; 600 vdcw; hermetically sealed, metal case; 1-7/16" max. lg. x 13/16" dia.; mineral oil filled; two axial wire leads. Measurements Corp. Dwg. H-3755.

C18 Should Read:
CAPACITOR: fixed; paper; .25 mfd; 600 vdcw. Measurements Corp. Dwg. H-5596.

Delete E2.

Delete I1.

L2 Should Read:
REACTOR: filter choke; 12 hy. ± 10% at 500 cycles at 1V; A.C. resistance; 2000 to 3000 ohms at 500 cycles; open frame 3-3/8" max. lg. x 1-7/8" max. w. x 2" h.; two mounting holes 3/16" dia. at 2-13/16" centers; two wire leads on one side. Measurements Corp. Dwg. H-3531.

Page 10 - L3 Should Read:
REACTOR: filter choke; 5 hy. ± 10% at 3000 cycles at 1V.; A.C. resistance, 30K ohms max. at 3000 cycles; open frame; 2-1/2" max. lg. x 1-3/8" max. w. x 1-1/2"h; two mounting holes 3/16" dia. at 2" centers; two wire leads on one side. Measurements Corp. Dwg. H-3532.

Page 10 - ADD:
P1 - CONNECTOR: plug; 2 male contacts; part of W1 cable assy.; not separately replaceable.

P1 - FUNCTION: Power Supply connector.

R2 - Delete "F characteristic"; change "H-5076" to "H-3734-223".

R5 - Delete "F characteristic"; change "H-5077" to "H-3734-154".

R6 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5078" to "H-3728-223".

R8 - Should Read:
RESISTOR: fixed; composition; 1000 ohms +10%; 1/2 w; 3/8" lg. x 9/64" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-3728-102.

R9 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5080" to "H-3728-104".

Page 11 - R10 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5081" to "H-3728-103".

R11 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5082" to "H-3727-513".

R12 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5083" to "H-3728-105".

R13 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5084" to "H-3728-224".

R19 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change H-5088" to "H-3728-152".

Page 12 - R23 - Change "H-5090" to "H-3745-18".

R26 - Delete "F characteristic"; change "5/32" dia." to "9/64" dia."; change "H-5091" to "H-3727-203".

R28 - Change "H-5092" to "H-3745-33".

R29 - Change "H-5093" to "H-3745-24".

R32 - Delete "F characteristic"; change "H-5095" to "H-3734-222".

ADD:
R33 - RESISTOR: fixed; composition; 680 ohm +10%; 1/2 w; 3/8" lg. x 9/64" dia. insulated; 2 axial wire leads; Measurements Corp. Dwg. H-3728-681.

Page 12 - S1 Should Read:
SWITCH: toggle; S.P.S.T.; 3 amp.; 250 vdc; molded phenolic body; 1-1/4" lg. x 11/16" w. x 21/32" deep; 1/2" lg. ball tipped handle; locking action; 2 solder lug terminals; single hole mounting; bushing 15/32-32 x 3/8" lg. Measurements Corp. Dwg. H-383-1.

Page 13 - T1 Should Read:
TRANSFORMER: Power; plate & filament type; input 117 volts 50-60 cycles single phase; 3 output windings; sec. #1-300-0-300V. A.C. at 50 ma D.C. load; 2 red leads & one red with yellow tracer lead; sec. #2, 6.3V at 2.0 amp.; 2 green leads; sec. #3, 6.3V at 2.0 amp.; 2 brown leads; shell type metal case; 2-1/2" x 3" x 3-3/8" high; mount with four #8-32 screws on 2" x 2-1/2" centers. Measurements Corp. Dwg. H-5405.

V1 Should Read:
TUBE: electron; RETMA 6X5GT or 6X5.

V2 Should Read:
TUBE: electron; RETMA #6J5GT or 6J5.

V3 Should Read:
TUBE: electron; RETMA #12AX7.

V4 Should Read;
TUBE: electron; RETMA #12AT7.

Delete X1, X2.

Delete X3, X4.

FRONT VIEW OF MODEL 31

CHAPTER 1

INTRODUCTION

Section I. DESCRIPTION

1. GENERAL

a. The Model 31 Intermodulation Meter consists of two sections: a generator which supplies a mixed audio signal to the apparatus under test, and an analyzer section which reads directly the output voltage and the percentage of intermodulation produced by the apparatus under test.

TABLE OF SPECIFICATIONS

Dimensions	Weight	Operating Voltage	Input Power	Tubes
8" high x 19" wide x 9"deep. Fits standard 7" relay rack panel space.	16 lbs.	117 volts 50/60 cycles Fuse: 1/2A Slow Blow	30 watts	1 - 12AX7 1 - 12AT7 1 - 6J5GT 1 - 5Y3GT

GENERATOR	ANALYZER
Low Frequency: 60 cycles High Frequency: 3000 cycles LF/HF Voltage Ratio: Fixed 4/1 Output Voltage: 10v max. of mixed signal into a high impedance or +5 DBM when matched to 600 ohms. Output Impedance: 2000 ohms Residual Intermodulation: 0.2% maximum.	Input Voltage: Full scale voltmeter ranges of 3, 10 and 30 volts RMS are provided. Less than one volt of mixed signal is sufficient for operation. Input Impedance: Greater than 400K ohms. Intermodulation: Full scale ranges of 3, 10 and 30%. Accuracy: ± 10% of full scale.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF INSTRUMENT

2. GENERAL

a. After the instrument has been unpacked it should be inspected for evidences of damage during shipment and a preliminary operating check should be made as follows:

(1) Connect the power cord to a source of 117 volt, 50/60 cycle current and throw the power switch to the ON position. The pilot light should light.

(2) Turn both INPUT and OUTPUT control knobs fully counter-clockwise. Set selector switch to 10 volt position.

(3) Connect an oscilloscope to the OSCILLOSCOPE binding posts. Connect the upper OUTPUT binding post to the upper INPUT binding post.

(4) Rotate the OUTPUT control clockwise. The meter should start to read, and at full output should read approximately 8 to 10 volts. The oscilloscope should show the mixed output signal of 3000 cycles superimposed on 60 cycles.

(5) Set the selector switch to the CARRIER SET position and turn the INPUT control knob clockwise until the meter reads full scale. The oscilloscope should show the unmodulated 3000 cycle carrier.

(6) Turn the selector switch to the 3% INTERMODULATION position. The meter should read well below the 1 mark on the 10 scale and the oscilloscope should show a residual trace of 3000 cycle carrier mixed with a trace of 60 cycle.

b. If the instrument operates as indicated in the above procedure, it may be assumed to be operating correctly.

Section II. OPERATION

3. PRECAUTION

a. Since one side of both the input and output of the Model 31 is grounded to the case, isolating transformers may be necessary in some cases when using it with amplifiers having balanced or isolated inputs or outputs.

NOTE: The overall frequency response of the system under test should be flat within a few db between 60 and 3000 cycles or misleading results may be obtained.

4. MEASURING THE PERCENTAGE OF INTERMODULATION IN AN AMPLIFIER

a. Connect the OUTPUT binding posts of the Model 31 to the input terminals of the amplifier under test. If it is desired to match the Model 31 to a 600-ohm line, this may be done by placing a 1000-ohm resistor across the output terminals. This will reduce the 2000-ohm output impedance to approximately 600 ohms.

b. The output of the amplifier under test should be terminated in its proper load impedance by a resistor or other suitable load and connected to the INPUT binding posts of the Model 31. If the amplifier delivers a maximum output voltage of more than 30 volts, a suitable tapped resistor or pad of known voltage ratio should be placed between the output of the amplifier under test and the Model 31.

c. Set the selector switch of the Model 31 to the appropriate VOLTS INPUT range for reading the maximum output voltage of the amplifier under test.

d. Adjust the OUTPUT control of the Model 31 and/or the input gain control of the amplifier under test until the amplifier gives the desired output voltage.

NOTE: Since any average or RMS meter, such as is used in the Model 31, will almost ignore the 3000 cycle signal superimposed on the 60 cycle signal, the output voltages read on the meter should be multiplied by a factor of 1.25 to de-

termine the true maximum output voltage.

e. Set the selector switch of the Model 31 to the CARRIER SET position and adjust the INPUT control knob until the meter reads full scale.

f. Set the selector switch of the Model 31 to the appropriate % INTERMODULATION range and read the percentage directly on the meter.

5. MEASURING THE PERCENTAGE OF INTERMODULATION IN A TAPE OR DISC RECORDING SYSTEM

a. Connect the output of the Model 31 to the input of the recorder as in Paragraph 4, a.

b. Adjust the OUTPUT control of the Model 31 and/or the input gain control of the recorder for the proper recording level.

c. Record for 15 seconds or more as desired.

NOTE: It is often desirable to make several test recordings at levels above and below "normal" level in order to determine the maximum permissible recording level.

d. Connect the output of the playback amplifier to the INPUT terminals of the Model 31, as in Par. 4, b.

e. Adjust the playback gain control for the proper level.

f. Set the selector switch of the Model 31 to the CARRIER SET position.

g. Start the play back and adjust the INPUT control of the Model 31 for full scale.

h. Set the selector switch of the Model 31 to the appropriate % INTERMODULATION range and read the percentage directly on the meter.

6. CHECKING TRACKING AND DISTORTION IN PHONOGRAPH PICKUPS

a. Proceed as in Par. 5, d, e, f, g and h.

b. Commercially available test phonograph records may be used with the analyzer section of the Model 31 for checking phonograph pickups provided they have the following characteristics:

(1) Low frequency between 40 and 100 cycles.

(2) High frequency between 3000 and 10,000 cycles.

(3) High frequency level 0 to 12 db below low frequency level.

c. A test record may be cut from the generator section of the Model 31 in accordance with Par. 5, a, b, c, provided the intermodulation distortion of the cutter is known to be low.

7. MEASURING THE INTERMODULATION DISTORTION IN AN AM OR FM TRANSMITTER

a. Connect the OUTPUT terminal of the Model 31 to the input of the transmitter, as in Par. 4, a.

b. Connect the OUTPUT of the transmitter monitor to the INPUT terminals of the Model 31, as in Par. 4, b.

c. Adjust the OUTPUT control of the Model 31 and/or the input gain control of the transmitter to the desired percentage of modulation or deviation.

NOTE: Unless the percent modulation, or deviation, indicator in the monitor is of the peak type, the percentage or deviation should be multiplied by 1.25 as explained in the note following Par. 4, d.

d. Proceed as in Par. 4, e and f.

CHAPTER 3

MAINTENANCE

8. REMOVING INSTRUMENT FROM CASE

a. Place instrument on its back on the bench.

b. Remove four 10-32 screws in the slots at the edges of the panel.

c. Remove two 6-32 screws at the top of the panel on either side of the meter.

d. Remove two 6-32 screws at the back of the bottom of the case.

e. Lift instrument out of case.

9. REPLACING OF TUBES

a. Tubes may be replaced by others of the same types, usually without upsetting the calibration of the instrument. It should always be checked, however, by the procedure under OPERATING INSTRUCTION General Par. 1 through Par. 6, to make sure that spurious intermodulation has not been introduced.

10. VOLTMETER CALIBRATION

a. Voltmeter calibration may be checked by comparing it to an AC Voltmeter of known accuracy at 60 cycles. If necessary, it may be reset by adjusting the METER CAL potentiometer at the back of the chassis.

11. % INTERMODULATION CALIBRATION

a. Equipment required for this test is: two audio oscillators capable of tuning to approximately 3000 cycles and giving up to 10 volts output into 10K ohms; a voltmeter capable of reading 10 volts and 1 volt at 3000 cycles with good accuracy, and two matched resistors of approximately 10K ohms each.

(1) Connect each audio oscillator through a resistor to the input of the Model 31.

(2) Set one oscillator to approximately 3000 cycles and the other to approximately 3100 cycles.

(3) Set the output of one oscillator to 10 volts and the other to 1 volt.

(4) Set the selector switch of the Model 31 to 10% INTER-MODULATION and adjust the INPUT control until meter reads full scale.

(5) Set the selector switch to CARRIER SET and adjust the "Carrier Set" potentiometer at the back of the chassis until meter reads full scale.

12. LF/HF RATIO ADJUSTMENT

a. Equipment needed for this adjustment consists of a Voltmeter capable of reading 4 volts and 1 volt with good accuracy between 60 and 3000 cycles.

(1) Remove the instrument from its case.

(2) Connect the voltmeter to the output terminals of the Model 31.

(3) Remove the 6J5GT tube.

(4) Adjust the OUTPUT control until the voltmeter reads 4 volts.

(5) Without changing the OUTPUT control adjustment, remove the power cord plug from the line supply and unsolder the connection between the plate of the 5Y3GT rectifier and R2.

(6) Replace power cord plug and replace 6J5GT tube.

(7) Adjust HF OUTPUT potentiometer until voltmeter reads 1 volt.

(8) Remove power cord plug and resolder connection to plate of 5Y3GT.

(9) Replace instrument in case.

TABLE OF REPLACEABLE PARTS

MODEL 31 INTERMODULATION METER **MAJOR UNIT:**

Reference Symbol	DESCRIPTION	FUNCTION
C1,C2 C3	CAPACITOR: fixed; electrolytic; 3 sections; 10-10-10 mfd; 450 vdcw. each section; working temp. range -40°C. to +85°C. 3" lg. x 1" dia.; tubular metal case; 3 solder lug terminals for positive connections; common negative connection to shell. Mounts on metal plate which has two holes 9/64" dia. at 1-1/2" centers. Measurements Corp. Dwg. H-5061.	Plate supply filter.
C4	CAPACITOR: fixed; paper; .05 mfd. ±20%; 600 vdcw; hermetically sealed, metal case; 1-5/8" lg. x 3/4" dia. max.; mineral oil filled; two axial wire leads. Measurements Corp. Dwg. H-5062.	Low frequency harmonic filter.
C5	CAPACITOR: fixed; paper; .02 mfd. ±10%; 600 vdcw; hermetically sealed, metal case; 1-3/4" lg. x 1/2" dia. max.; mineral oil filled; two axial wire leads. Measurements Corp. Dwg. H-5063.	High frequency tank capacitor.
C6	CAPACITOR: fixed; ceramic dielectric; 5,000 mmf. min; 500 vdcw; 9/16" dia. x 1/8" thick; two parallel leads. Measurements Corp. Dwg. H-5064.	H.F. oscillator grid capacitor.
C7	CAPACITOR: fixed; ceramic dielectric; 10,000 mmf. min; 500 vdcw; 1-1/8" lg. x 3/16" dia.; two radial wire leads. Measurements Corp. Dwg. H-5065.	High frequency coupling capacitor.
C9	CAPACITOR: fixed; mica dielectric; .001 mfd. ±20%; 500 vdcw; temp. coef. A or B; 25/32" lg. x 25/32" w. x 9/32" thick; molded bakelite case; two axial wire leads. Measurements Corp. Dwg. H-5066.	Input coupling capacitor.
C10	CAPACITOR: fixed; silver mica; 500 mmf. ±10%; 500 vdcw; temp. coef. A or B; 51/64" lg. x 15/32" w. x 7/32" thick max.; molded bakelite case; two axial wire leads. Measurements Corp. Dwg. H-5067.	Input coupling capacitor.
C11	CAPACITOR: fixed. Same as C10.	High-pass filter capacitor.
C12	CAPACITOR: fixed; ceramic dielectric; 100 mmf. ±10%; 500 vdcw; zero temp. coef.; 13/16" lg. x 5/32" dia.; two radial wire leads. Measurements Corp. Dwg. H-5068.	Interstage coupling capacitor.
C13	CAPACITOR: fixed; mica dielectric; .01 mfd. ±10%; 300 vdcw; 27/32" lg. x 27/32" w. x 11/32" thick; molded bakelite case; two axial wire leads. Measurements Corp. Dwg. H-5069.	Demodulator cathode bypass.
C14	CAPACITOR: fixed; mica dielectric; .005 mfd. ±10%; 500 vdcw; 27/32" lg. x 27/32" w. x 11/32" thick; molded bakelite case; two axial wire leads. Measurements Corp. Dwg. H-5070.	Low-pass filter capacitor.
C15	CAPACITOR: fixed. Same as C13.	Low-pass filter capacitor.

TABLE OF REPLACEABLE PARTS

MODEL 31 INTERMODULATION METER **MAJOR UNIT:**

Reference Symbol	DESCRIPTION	FUNCTION
C16	CAPACITOR: fixed. Same as C4.	% IM coupling capacitor.
C17	CAPACITOR: fixed. Same as C9.	High-pass filter capacitor.
C18	CAPACITOR: fixed; paper; .25 mfd. ±20%; 600 vdcw; hermetically sealed, metal case; 2-13/16" lg. x 13/16" dia. max.; mineral oil filled; two axial wire leads. Measurements Corp. Dwg. H-5071.	Meter coupling capacitor.
C19	CAPACITOR: fixed; paper dielectric; .1 mfd. ±20%; 200 vdcw; 1-1/2" lg. x 1/2" dia.; molded plastic case; two axial wire leads. Measurements Corp. Dwg. H-5072.	Oscilloscope coupling capacitor.
C20	CAPACITOR: fixed. Same as C7.	Voltmeter blocking capacitor.
E1	LAMP: incandescent; 6-8v. .25 amp; bulb T-3-1/4 clear; 1-1/8" lg. overall; miniature bayonet base; burn any position. Measurements Corp. Dwg. H-5016.	Pilot light.
E2	HOLDER: fuse; panel type; for one glass cartridge fuse; black bakelite; 15 amp. 250 v.;11/16" dia. x 2-1/2" lg. overall; 1/2" dia. threaded body for panel hole mounting; 2 solder lug terminals; bayonet type knob. Includes washer and mounting nut. Measurements Corp. Dwg. H-5017.	Fuseholder.
F1	FUSE: cartridge; 1/2 amp. slow acting; rated continuous for 110% load, opens in one hour at 135% load; opens in 25 seconds at 200% load; 250 v. one time; glass body; metal ferrules; 1-1/4" lg. x 1/4" dia. Measurements Corp. Dwg. H-5073.	Line fuse.
I1	LIGHT: indicator; with lens; 1/2" dia.; red smooth lens; for miniature bayonet base,T-3-1/4 bulb; 6-8 v; .25 amp; open frame; nickle plated steel shell; 1-3/4" lg. x 15/16" w. x 1" overall; 11/16" mtg. hole;1/4"max. panel thickness; horizontally mounted; lamp removable from front of panel; two solder lugs at base of socket. Measurements Corp. Dwg. H-5074.	Pilot light holder.
L1	COIL: A.F.; layer wound; unshielded; inductance 134 millihenries ±5%; D.C. resistance 184 ohms approx.; 1-1/4" lg. x 1-1/2" dia.;lead wires parallel at same end; mounts with one #6 x 3/4 R.H. wood screw. Measurements Corp. Dwg. H-3248.	High frequency tank inductance.
L2	REACTOR: filter choke; 10 hy. at 65 ma.; 400 ohm D.C. resistance max; 1500 v. RMS test; open frame 3-5/32" lg. x 1-1/2" w. x 2 h.; two mounting holes 3/16" dia. at 2-3/4" centers; two wire leads on one side. Measurements Corp. Dwg. H-2705.	Low-pass filter inductance.

TABLE OF REPLACEABLE PARTS

MODEL 31 INTERMODULATION METER

MAJOR UNIT:

Reference Symbol	DESCRIPTION	FUNCTION
L3	REACTOR: filter choke; 4.5 hy. at 50 ma.; 300 ohms D.C. resistance; 1500 v. RMS test; open frame; 2-3/8" lg. x 1-3/8" w. x 1-3/8" h; two mounting holes 3/16" dia. at 2" centers; two wire leads on one side. Measurements Corp. Dwg. H-5075.	High-pass filter inductance.
M1	METER: ammeter; AC type; 0-225 microamps; rect. bakelite case; panel mtg. type; barrel 2-3/4" dia. x 1" d; 1" d. behind panel face; rect. flange 4-17/64" w. x 3-31/32" h. x 45/64" d; full scale accuracy ±10% ; D'Arsonval movement; 1125 mv. max. drop; 5000 ohm max. across terminals; calibrated for non-magnetic panel; two scales; "% INTERMODULATION OR INPUT VOLTS RMS" 0-10, forty-six divisions, 0-30 twenty-six divisions; black numerals on white background; self-contained; four mtg. holes 5/32" dia. at 3-5/8" horizontal and 3-5/16" vertical centers, two stud terminals #10-32 x 3/4" lg. max. spaced at 1" centers.Measurements Corp. Dwg. H-878.	Meter.
R2	RESISTOR: fixed; composition; 22,000 ohms ±10% ; 2 w; F characteristic; 11/16" lg. x 5/16" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5076.	Low frequency dropping resistor.
R3	RESISTOR: fixed. Same as R2.	Low frequency dropping resistor.
R4	RESISTOR: fixed. Same as R2.	Low frequency dropping resistor.
R5	RESISTOR: fixed; composition; 150,000 ohms ±10%; 2 w.; F characteristic; 11/16" lg. x 5/16" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5077.	Bleeder resistor.
R6	RESISTOR: fixed; composition; 22,000 ohms ±10%; 1/2 w;F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5078.	Plate supply filter resistor.
R7	RESISTOR: fixed. Same as R2.	Plate supply filter resistor.
R8	RESISTOR: fixed; composition; 1500 ohms ±10%; 1/2 w; F characteristic ; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5079.	High frequency oscillator cathode resistor.
R9	RESISTOR: fixed; composition; 100,000 ohms ±10%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5080.	H.F. oscillator grid resistor.

TABLE OF REPLACEABLE PARTS

MODEL 31 INTERMODULATION METER **MAJOR UNIT:**

Reference Symbol	DESCRIPTION	FUNCTION
R10	RESISTOR: fixed; composition; 10,000 ohms ±10%; 1/2 w; F character - istic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5081.	Parasitic oscillation suppressor.
R11	RESISTOR: fixed; composition; 51,000 ohms ±5%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5082.	1st amplifier plate resistor.
R12	RESISTOR: fixed; composition; 1 megohm ±10%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5083.	2nd amplifier plate resistor.
R13	RESISTOR: fixed; composition; 220,000 ohms ±10%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5084.	Meter amplifier plate resistor.
R14	RESISTOR: variable; wire wound; 20,000 ohms ±10%; 4 w; 3 solder lug terminals; molded case with metal back; 1-13/16" dia. x 15/16" deep; enclosed; round metal shaft, 1/4" dia. x 1/8" lg. beyond bushing, slotted for screw driver adjustment; linear taper; contact arm insulated; bushing 3/8-32 x 3/8" lg. Measurements Corp. Dwg. H-5085.	High frequency output adjust.
R15	RESISTOR: variable; wire wound; 2,000 ohms ±10%; 4 w; 3 solder lug terminals; molded case with metal back; 1-13/16" dia. x 15/16" deep; enclosed; round metal shaft 1/4" dia. x 1/2" lg. beyond bushing; linear taper; contact arm insulated; bushing 3/8-32 x 3/8" lg. Measurements Corp. Dwg. H-5086.	Output control.
R16	RESISTOR: variable; composition; 500,000 ohms ±20%; 1 w; 3 solder lug terminals; bakelite case 1-7/16" dia. x 9/16" d.; metal cover; round metal shaft, 1/4" dia. x 1/2" lg. from bushing; audio taper; contact arm insulated; normal torque; bushing 3/8-32 x 3/8" lg. Measurements Corp. Dwg. H-5087.	Carrier adjust control.
R18	RESISTOR: fixed. Same as R12.	1st amplifier grid resistor.
R19	RESISTOR: fixed; composition; 1500 ohms ±10%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia.; insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5088.	1st.amplifier cathode resistor.
R20	RESISTOR: fixed. Same as R9.	2nd amplifier grid resistor.

TABLE OF REPLACEABLE PARTS

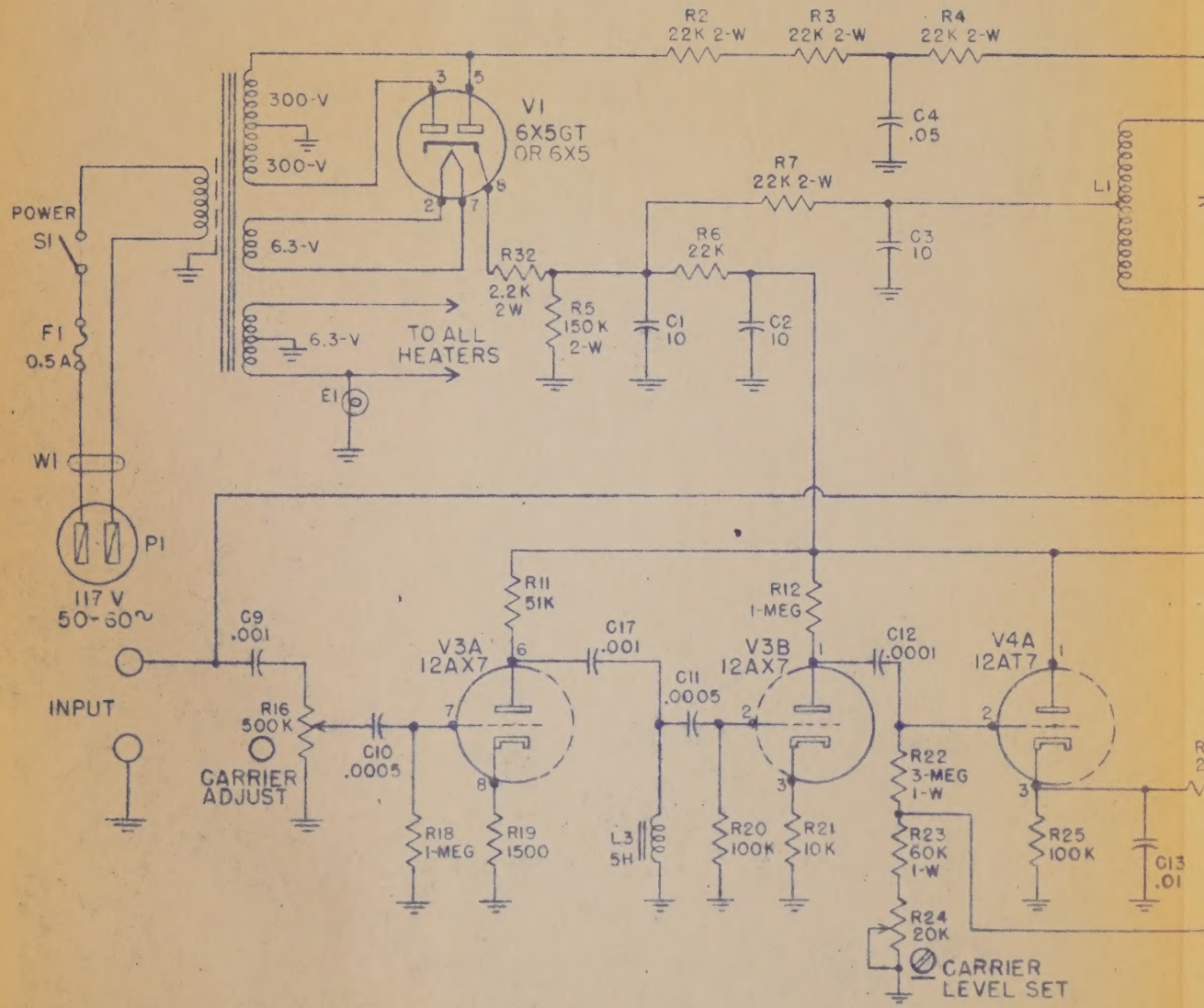
MODEL 31 INTERMODULATION METER **MAJOR UNIT:**

Reference Symbol	DESCRIPTION	FUNCTION
R21	RESISTOR: fixed. Same as R10.	2nd amplifier cathode resistor.
R22	RESISTOR: fixed; metal film; 3 megohms ±2%; 1 w; 1" lg. x 9/32" dia. ceramic tube; moisture-proofed; 2 radial wire leads. Measurements Corp. Dwg. H-5089.	Demodulator grid resistor.
R23	RESISTOR: fixed; metal film; 60,000 ohms ±2%; 1 w; 1" lg. x 9/32"dia. ceramic tube; moisture-proofed; 2 radial wire leads. Measurements Corp. Dwg. H-5090.	Demodulator grid resistor.
R24	RESISTOR: variable. Same as R14.	Carrier set adjust.
R25	RESISTOR: fixed. Same as R9.	Demodulator cathode resistor.
R26	RESISTOR: fixed; composition; 20,000 ohms ±5%; 1/2 w; F characteristic; 3/8" lg. x 5/32" dia., insulated; 2 axial wire leads. Measurements Corp. Dwg. A-5091.	Low-pass filter terminating resistor.
R27	RESISTOR: fixed. Same as R22.	Voltmeter input resistor.
R28	RESISTOR: fixed; metal film; 420,000 ohms ±2%; 1 w; 1" lg. x 9/32" dia. ceramic tube; moisture-proofed; 2 radial wire leads. Measurements Corp. Dwg. H-5092.	Voltmeter divider resistor.
R29	RESISTOR: fixed; metal film; 120,000 ohms ±2%; 1 w; 1" lg. x 9/32" dia, ceramic tube; moisture-proofed; 2 radial wire leads. Measurements Corp. Dwg. H-5093.	Voltmeter divider resistor.
R30	RESISTOR: fixed. Same as R23.	Voltmeter divider resistor.
R31	RESISTOR: variable; wire wound; 3,000 ohms ±10%; 4 w; 3 solder lug terminals; molded case with metal back; 1-13/16" dia. x 15/16" deep; enclosed; round metal shaft 1/4" dia. x 1/8" lg. beyond bushing, slotted for screw driver adjustment; linear taper; contact arm insulated; bushing 3/8-32 x 3/8" lg. Measurements Corp. Dwg. H-5094.	Meter adjust.
R32	RESISTOR: fixed; composition; 2,200 ohms ±10%; 2 w; F characteristic; 11/16" lg. x 5/16" dia. insulated; 2 axial wire leads. Measurements Corp. Dwg. H-5095.	Plate supply input resistor.
S1	SWITCH: toggle; S.P.S.T.; 3 amp.; 250 vdc; molded case; 1-1/4" lg. x 11/16" w. x 11/16" deep; 1/2" lg. ball tipped handle; locking action; 2 solder lug terminals; single hole mounting; bushing 15/32-32 x 3/8" lg. Measurements Corp. Dwg. H-5096.	Power switch.

TABLE OF REPLACEABLE PARTS

MODEL 31 INTERMODULATION METER **MAJOR UNIT:**

Reference Symbol	DESCRIPTION	FUNCTION
S2	SWITCH: rotary; 2 pole, 7 position; silver plated brass contacts and rotors; bakelite wafers; 1-9/16" w. x 1-7/8" h. x 2" lg. from mounting surface; shorting type contacts at front section, non-shorting type contacts at rear section; locking action; solder lug terminals; single hole mounting; bushing 3/8-32 x 1/4" lg; 1/4" dia. shaft 7/8" lg. from mounting surface. Measurements Corp. Dwg. H-4134.	Function and range switch.
T1	TRANSFORMER: power; plate and filament type; input 117 v. 50-60 cycle, single phase, 3 output windings; Sec. #1, 650 v. CT @ 40 ma.; Sec. #2, 5 v. CT @ 3 amp; Sec. #3, 6.3 v. CT @ 2 amp; double shell enclosure; 3" x 2" x 2-3/4" h; wire leads, all through lower shell; mounts on four screws #8-32 on 2" x 2-1/2" centers. Measurements Corp. Dwg. H-5097.	Power transformer.
V1	TUBE: electron; RMA #5Y3GT rectifier.	Plate supply rectifier.
V2	TUBE: electron; RMA #6J5GT triode.	H.F. oscillator.
V3	TUBE: electron; RMA #12AX7 twin triode.	1st and 2nd amplifier.
V4	TUBE: electron; RMA #12AT7 twin triode.	Demodulator and meter amp.
W1	CABLE ASSEMBLY: power; 2 cond. #18 AWG, 16 strands #30 AWG; 6 ft. lg; one end terminated in plug, other end unterminated. Measurements Corp. Dwg. H-704.	Power cord.
X1,X2	SOCKET: tube; octal; one piece saddle mtg.; two 9/64" dia. mounting holes on 1-1/2" centers; round plastic body 1-3/16" dia. x 1/2" h. excluding terminals; spring brass cadmium plated terminals. Measurements Corp. Dwg. H-5056.	
X3,X4	SOCKET: tube; noval; one piece saddle mtg; two 1/8" dia. mounting holes on 1-1/8" centers; round plastic body in 15/16" dia. shield base; spring brass cadmium plated terminals; center shield 5/32" I.D. Measurements Corp. Dwg. H-5098.	
	KNOB: round; black bakelite; for 1/4" dia. shaft; 2 set screws #8-32; 1-3/8" dia. x 11/16" h. overall; brass insert counterbored. Measurements Corp. Dwg. H-2788.	
	KNOB: round; skirted; black bakelite; for 1/4" dia. shaft; 2 set screws #10-32; 2-1/16" dia. x 29/32" h. overall. Measurements Corp. Dwg. H-5099.	



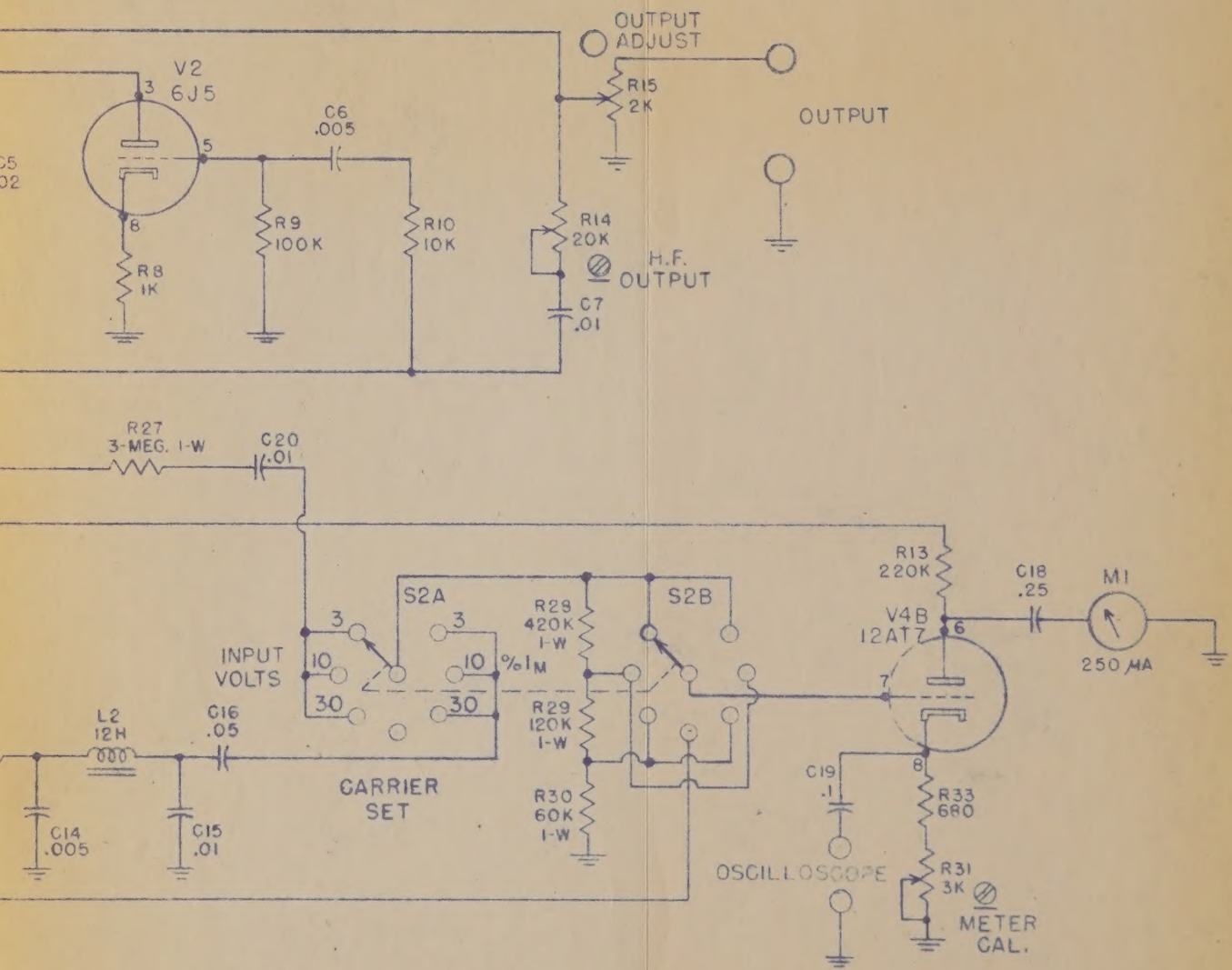
○ = FRONT PANEL CONTROL.

⊘ = SCREW DRIVER ADJUST BEHIND PANEL.

K = 1000.

UNLESS OTHERWISE SPECIFIED:-
ALL CAPACITANCES IN MICROFARADS.
ALL RESISTORS ½ WATT.
ALL RESISTANCES IN OHMS.

SCHEMA
M



IC DIAGRAM

DEL-31

MEASUREMENTS

BOX 180, BOONTON
NEW JERSEY

MP MASTER
MA24730